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Attachments

- Letter from Chairman R. Wiley re use of Sony Camera
- Letter from David Sarnoff Research Ctr. re Transconversion
- Report of the Ad Hoc Group on Production Planning
- PS/WP-6 Document List

I. EXECUTIVE SUMMARY

This is the fourth interim report of Working Party 6 on Subjective Assessments. During this period, the efforts of the Working Party were centered on one primary task -- that of producing the high definition and NTSC test materials, both motion and still, needed for conduct of the FCC Advisory Committee's subjective test plans. This report will focus primarily on this activity, although the Working Party's other activities will also be reported.

Working Party 6 held seven meetings during the period, as follows: April 11, May 10, May 25, July 11, September 14, and November 8, 1990; and Jan. 24, 1991.

The Working Party's Ad Hoc Group on Production Planning, chaired by NBC's Alan Godber, held eight meetings. A Camera Test Subgroup, with Hank Mahler of CBS as test manager, met three times formally, and many times during actual lab testing of the high definition cameras. Finally, a Film Transfer Task Force chaired by Carl Eilers of Zenith Electronics Corporation met twice via telephone. Jim Gaspar of Panasonic acted as Chairman of the Ad Hoc Group on Production Support, which held no meetings, but which organized the technical aspects of the production of the video-based test materials. The Working Party's Ad Hoc Group on Still Test Material, chaired by Bronwen Jones, held several meetings with NASA and Kodak, and in September, successfully delivered to the Advanced Television Test Center the digital data tapes of the still test images.

As of the date of this report, the Working Party has successfully completed production of the studio portion of the test materials, although some post-production editing is required before delivery to the Advanced Television Test Center and Cable Television Laboratories. It is expected that this material will be edited and ready for final delivery by March 22, 1991.

The Working Party has also successfully recorded the raw

footage for the so-called "proponent" material. These are the ten 2-minute scenes intended for delivery to each of the ATV system proponents (not including Zenith or MIT, who did not participate in this phase of the production). This material is for the laboratory use of the ATV system proponents in preparing their systems for test. At the time of this writing, the post-production editing of this proponent material still remains to be performed. The material shot consists of exterior scenes of New York City in the necessary high definition formats. It is intended to provide a wide range of material for proponents' system testing, without duplicating, or thereby compromising, the integrity of the official subjective test material. -

Finally, the Working Party, as part of the production of the studio-based video material, and with the cooperation of the Advanced Television Test Center, recorded in all five formats the mechanically-rotated dynamic resolution patterns needed for objective testing of the proposed ATV systems.

Remaining on the Working Party's work schedule in the coming weeks are the final verification of the technical performance of the multi-format telecine system being built under contract to Zenith Electronics Corporation by Showscan Film Corporation and with the assistance of BTS, Inc. When this system is verified as having satisfactory technical performance, the four film segments, each 10 seconds in length, will be transferred to the four high definition video formats and to NTSC. These will include two scenes at 24 frames per second, one scene at 30 frames per second, and one 70mm scene at 60 frames per second.

Finally, the Working Party must complete the computer-based rendering of a single 10-second motion sequence and a single still image, and transfer the resultant digital image data to the four high definition video formats and to NTSC. AT&T Bell Laboratories is completing a final, detailed technical proposal describing this work, and PS/WP-6 expects to be able to give a go-ahead for the rendering work to begin at Bell Labs. Conversion of the master rendered image to the five required formats and the final recording of these images is

expected to be completed by April 3, 1991.

While there remains some substantial work ahead, it is appropriate here to recognize the valuable contributions by the ATV system proponent organizations, the test laboratories and the broadcasters who made cash contributions to the production of the test materials; to thank the many companies who loaned valuable equipment to the effort, and to express gratitude to those who volunteered their expertise and in some cases, many, many weeks of labor away from their normal job responsibilities to make the technical complement of equipment work successfully.

Deserving of special commendation are Jim Gaspar of the Panasonic Advanced Television & Video Laboratory, who served as Technical Coordinator for the studio and exterior productions; and Paul Hearty of the Advanced Television Evaluation Laboratory in Ottawa, Canada, who served as Content Coordinator for the studio-based scenes. Thanks also to Alan Godber and Jay Ballard of NBC, who contributed substantial time and expertise. All those working on this project did so under conditions of extreme time and cost pressure. They successfully resolved many technical challenges never before met in any video production. Credit is also due Phil Crosby of Tektronix Corporation, for his work in interfacing the Tektronix Format Converter to the Sony digital high definition video tape recorders at the production site to allow digital recording of the high definition video signals.

Deserving of special recognition is NHK, who designed and built the HDTV Transconverter which will be used to derive some of the subjective test materials from camera-originals in the 1125/60/2:1 format.

Recognition is also due to David Niles and the staff of his company, Captain of America, the New York-based high definition production company which was contracted by the Working Party to handle the creative aspects of the production.

II. STATEMENT OF WORK FOR THE FOURTH PERIOD OF WORK

The March, 1990 Third Interim Report of the Planning Subcommittee of the FCC Advisory Committee on Advanced Television Service set forth the following statement of further work for the Working Party on Subjective Assessments:

"PS/WP-6 has several major assignments it intends to complete in the near future. The first is to revise and approve the still test material. The second task is to ensure that the source material demonstration is conducted, and, following a decision as to the manner in which the material will be produced, to conclude production of the dynamic source material and have it ready for testing no later than September 1, 1990. Finally, PS/WP-6 expects to examine both the telecine system to be used for transferring the 35mm/24 fps film images to video tape and the high definition television cameras used in the production of motion sequence test material to ensure that the resulting image quality of these devices is state-of-the-art."

III. STATEMENTS OF PROGRESS

A. FUNDING STATUS FOR SUBJECTIVE TEST MATERIALS

Following is a statement of the funds contributed by various parties for the production of the subjective test materials:

Cable Television Laboratories, Inc.	\$100,000
David Sarnoff Research Center	60,000
General Instrument Corporation	60,000
Massachusetts Institute of Technology	60,000
NHK (Japan Broadcasting Corporation)	60,000
Philips Consumer Electronics	60,000

(cont'd. next page)

(continued)

Zenith Electronics Corporation	60,000
Advanced Television Test Center, Inc.	50,000
CBS Inc.	30,000
Capital Cities/ABC Inc.	<u>20,000</u>

TOTAL FUNDS CONTRIBUTED	\$560,000
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As of the date of this report, final expense totals against these collected funds are not available, but the Chairman of the Working Party believes the funds will be nearly fully expended, as planned. A final statement will be issued by the Chairman within the next few months, when the production of the complete set of subjective test materials is completed.

B. VIDEO-ORIGINATED MOTION TEST MATERIALS

TEST SEQUENCES PRODUCED

The following motion (or "dynamic") test sequences have been recorded and will be delivered to the Advanced Television Test Center and to Cable Television Laboratories:

Format indications at column headings

are as follows: 1125 indicates 1125/60/2:1
1050 indicates 1050/59.94/2:1
525-P indicates 525/59.94/1:1
787-P indicates 787-788/59.94/1:1.

Basic Quality Test Sequences

	<u>1125</u>	<u>1050</u>	<u>525-P</u>	<u>787-P</u>	<u>NTSC</u>
1. Window	x	x	x	x	x
2. Fax Machine	x	x	x	x	x
3. Paint Store	x	x	x	x	x
4. Mannequins	x	x	x	x	x
5. Living Room	x	x	xx	x	x
6. Den	x	x	xx	x	x
7. Park Ride	x	x	x	x	x
8. Bubbles	x	x	x	x	x
9. Audience	x	x	xx	x	x
10. Woman & Room	x	x	x	x	x

Note that those marked with an "xx" in the 525-P column are scenes that were not produced directly via use of a camera operating in the 525-progressive scanning format. As the production work progressed, it became clear that time and budgetary constraints would preclude the original camera recording of all scenes in all formats. Through prior agreement with the David Sarnoff Research Center (the proponent whose system will be tested with 525-progressive materials), the Working Party's on-site production team selected to bypass production of scenes 5, 6 and 9 on the stage, in order to be sure of delivering a complete set of test materials. The 525-progressive version of scenes 5, 6 and 9 will be derived via digital scan-conversion from the recorded 1125/60 material through use of the NHK-designed high definition transcoder.

Impairment Test Sequences

	<u>1125</u>	<u>1050</u>	<u>525-P</u>	<u>787-P</u>	<u>NTSC</u>
11. Lamp	x	x	x	x	--
12. Times Square	x	x	x	x	--
13. Co-Channel	x	x	x	x	--
14. Interferor	To be created in post-production.				

Note that scenes 11, 12 and 13 are marked with a "--" in the NTSC column, indicating that NTSC versions of these scenes were not produced. They are not needed, according to the Advisory Committee's ATV test plans.

DETERMINATION OF PRODUCTION TECHNIQUE

The March 1990 statement of work for PS/WP-6 directed that the Working Party conduct a feasibility demonstration of the two possible procedures for production of the motion test materials in the four necessary high definition formats. These possible procedures were as follows:

1. High definition video materials could be imaged in four distinct scanning formats by a camera (or cameras) actually operating in the required formats: 525-progressive, 787-progressive, 1050-interlace, and 1125-interlace formats.

The sequences would be recorded in serial fashion as opposed to in a parallel, or simultaneous fashion, to avoid parallax (angle of view) errors. Camera movement would be automated, and scene action would be repeated.

2. The full set of high definition video materials would be provided through use of only two cameras -- an 1125-interlace camera and a 787.5-progressive camera. The other two formats would be derived via standards conversion through use of the NHK-designed high definition transcoder.

Early in the working period, Working Party opinion was split regarding which of these techniques was preferable. Some were concerned about the ability of the first technique to provide suitably matched picture content, and about the difficulty and time that would be consumed in producing each scene five times (including NTSC).

Others were concerned about deriving test materials via transconversion with the NHK device. Some felt that such test material would already have been digitally processed in ways that would render its quality level lower than that which could be provided directly by a camera operating in the necessary format. The same group felt that transconverted test scenes might involve subtle differences which, while perhaps not immediately visible, could cause visible artifacts when concatenated with the compression algorithms contained in the some of the proponents' ATV systems.

The Working Party decided to perform a series of objective tests on the NHK transconverter to determine its suitability for use. A subjective examination of the transconverter's performance on July 11 had resulted in split opinions over the significance of artifacts in the transconverted pictures.

At the Working Party's September 14 meeting, the results of the transconverter tests were presented. Opinions again were split, although two of the proponent organizations that would be the recipients of any transconverted materials, North American Philips and the David Sarnoff Research Center, presented technical evidence to support their objections to

use of the device.

Final agreements reached at that meeting, as reflected in the minutes, were as follows:

The transconverted 1050/59.94/2:1 recorded signal is the preferred input for all image sequences for the General Instrument System (per GI's preference). [In the Working Party's meeting of November 8, it was further agreed that any proponent should have the option of using the transconverted materials rather than camera-originated materials].

A camera-originated recorded signal will be used for input to the Philips 1050/59.94/2:1 system (per Philips' preference).

The transconverted 525/59.94/1:1 signal recorded signal will be examined on a case by case basis at the time of production. Camera original recordings for 525/59.94/1:1 will only be made for image sequences for which the transconverted signal is deemed unacceptable by the David Sarnoff Research Center. [This flexibility on the part of the Sarnoff Center was ultimately taken advantage of for the production of three sequences, as noted on pages 7 & 8 of section III B., under the heading TEST SEQUENCES PRODUCED].

In summary then, it was decided to proceed with the production of the video-based motion test materials by attempting to shoot with cameras operating in each scanning format, subject to the time and/or budget pressure to transconvert some to 525-progressive.

HDTV CAMERA PERFORMANCE ISSUES

During the working period, there was considerable controversy over the proposed use of the Sony HDC-300 high definition video camera (instead of the BTS KCH-1000 camera) for generation of the required 1125/60/2:1 images. After much discussion, it was agreed by the Working Party in its

November 8 meeting, with the exception of disagreement by Zenith Electronics Corporation and BTS, that the Sony HDC-300 high definition video camera was acceptable for use in the production of test materials in place of BTS camera operating at 1125/60/2:1, provided that that colorimetry, gamma and the near-black transfer characteristic were modified to match that specified for the SMPTE 240M standard. (This was done by Sony).

General Instrument Corporation, NHK and CBS, among others, favored the use of the camera for its good resolution and noise performance, while Zenith Electronics Corporation, AT&T Bell Labs, and NBC, among others, felt that using a camera for one format that had superior noise performance would result in unfair generation of test sequences. Specifically, the Zenith/AT&T argument was that less noisy test material in a particular format would allow one particular proponent's digital compression system to provide better delivered picture quality, thus yielding an unintended unfairness in the test results.

The split results of the Working Party's January 24, 1991 discussions on this topic were forwarded to Advisory Committee Chairman Richard Wiley for consideration. On January 25, 1991, Mr. Wiley responded with a letter (a copy of which is appended to this report), which commented as follows:

"Although I concur generally with the notion that the Advisory Committee ought to be testing transmission systems not cameras, as a practical matter it is impossible to create a perfectly "level playing field" in testing systems with such fundamentally different parameters. Accordingly, so long as other proponents are not markedly disadvantaged, I believe that proponents ought to be allowed to use the best available source material. The facts here suggest that other proponents will not be disadvantaged to any significant degree.

...After carefully evaluating the various arguments, it

is my judgment that proponents ought to have the option of using test material produced with the Sony HDC-300 camera. Accordingly, I am instructing you to make the arrangements necessary to employ the Sony HDC-300 camera in the test material production effort."

In accordance with Chairman Wiley's direction, the Sony camera was incorporated in the production of the video-based images, and will also be incorporated in the transfer of the film-based images.

A report of the Ad Hoc Group on Production Planning is attached to this report. It details some of the primary findings with regard to signal-to-noise ratios of the cameras used. It also reports on the overall activities of this Ad Hoc Group.

C. FILM-ORIGINATED MOTION TEST MATERIALS

Remaining on the Working Party's work schedule in the coming weeks are the final verification of the technical performance of the multi-format telecine system being built under contract to Zenith Electronics Corporation by Showscan Film Corporation and with the assistance of BTS, Inc. When this system is verified as having satisfactory technical performance, the four film segments, each 10 seconds in length, will be transferred to the four high definition video formats and to NTSC. These will include two scenes at 24 frames per second, one scene at 30 frames per second, and one 70mm scene at 60 frames per second.

D. ELECTRONICALLY-ORIGINATED MOTION AND STILL TEST MATERIALS

The Working Party must also complete the computer-based rendering of a single 10-second motion sequence and a single still image, and transfer the resultant digital image data to the four high definition video formats and to NTSC. AT&T Bell Laboratories is completing a final, detailed technical

proposal describing this work, and PS/WP-6 expects to be able to give a go-ahead for the rendering work to begin at Bell Labs. Conversion of the master rendered image to the five required formats and the final recording of these images is expected to be completed by April 3, 1991.

E. APPROVAL OF FILM-BASED STILL TEST MATERIALS

On September 11, 1990, the Working Party delivered digital data tapes representing thirteen final, master, scanned high resolution images of subjective test stills to the Advanced Television Test Center.

A list of these still images follows:

<u>Title</u>	<u>Test Attribute(s)</u>
Metal Table and Chairs	Luminance Resolution
Vines	Luminance Resolution
Wavy Wall	Luminance Rendition
Columns	Luminance Dynamic Range
Tulips	Chrominance Resolution, Noise
Sculptures	Chrominance Resolution
Fruits & Vegetables	Color Gamut/Rendition
Toys	Chrominance Dynamic Range
Girl with Toys	Peripheral (Side Panel) Performance
Memorial Arch	Depth Portrayal
Woman with Roses	Noise, Interference
Lorain Harbor	Noise
Flower on Plate	Multipath/Microreflections

(A fourteenth still, to be electronically rendered via computer, has not yet been created or delivered. See section D of this report.)

These still test materials were originally photographed by NASA's Lewis Research Center specifically for this purpose. The film was processed and the negatives scanned to a digital tape storage format by Eastman Kodak Corporation.

As of this writing, it remains for a task force under the Systems Subcommittee's Working Party 2 on Testing to select the specific digital filtering to be applied to these scanned master stills to convert them to the four high definition formats required and to NTSC. The work of this group awaits the delivery of the completed PIXAR graphics systems and its associated software to the facilities of the Advanced Television Test Center.

F. RANDOMIZED RUNNING ORDERS FOR TESTS

The Vice Chairman of PS/WP-6 has prepared draft randomized running orders for the subjective tests involving non-expert viewers. These running orders propose how the various test sequences should be ordered for presentation to the many groups of non-expert viewers in order to achieve valid experimental results, without so-called "order effects".

These are under review and will be submitted for approval of the full Working Party in the near future. Once approved, they will be forwarded to the Advanced Television Test Center, Cable Television Laboratories, and to the Canadian Advanced Television Evaluation Laboratory.

G. EXPERT OBSERVER RECOMMENDATIONS

The Chairman and Vice-Chairman of the Working Party, at the direction of the Chairman of the Planning Subcommittee, are preparing lists of potential expert viewers that can be used by the testing laboratories to solicit qualified personnel to participate in the expert viewer panels required for ATV testing. These will be forwarded to the Chairman of the Planning Subcommittee for consolidation and further consideration.

H. CREATION OF AUDIO SUBJECTIVE TEST PLAN

A subjective test plan for the evaluation of the audio

systems incorporated in the proposed ATV transmission systems was prepared by the Vice Chairman of PS/WP-6 and forwarded to the Systems Subcommittee Working Party 2 for further consideration.

IV. STATEMENT OF FUTURE WORK FOR PS/WP-6

The Chairman of the Working Party anticipates that there will be no further assignments for the Planning Subcommittee's Working Party 6 on Subjective Assessments.

Craig K. Tanner
March 19, 1991

WILEY, REIN & FIELDING

1776 K STREET, N.W.
WASHINGTON, D. C. 20006
(202) 429-7000

RICHARD E. WILEY
(202) 429-7010

January 25, 1991

FACSIMILE
(202) 429-7049
TELEX 248349 WYRN UR

VIA TELECOPY

Craig K. Tanner
Vice President
Advanced Television Projects
Cable Television Laboratories, Inc.
1050 Walnut Street
Suite 500
Boulder, CO 80302

Dear Craig:

Lex Felker has briefed me on the stalemate PS/WP6 reached yesterday with respect to the use of the Sony HD300 camera in the test material production effort. As you know, this topic has been hotly debated. Lex and I have been kept informed on the various parties' positions through both direct correspondence and copies of letters between the parties. The matter at issue is whether the performance of the Sony camera is so substantially better than the BTS cameras (which may be used to produce source material for 1050/59.94 and 525 proscan, and which must be used for 787.5/59.94 material) that its use would unavoidably bias the results of the Advisory Committee's tests. The concern is that, because noise contains many high frequency components and it is high frequency picture components which require the greatest amount of compression, all other things being equal, proponent systems evaluated with relatively noisy pictures will appear to have poorer picture quality.

The facts as I see them are as follows:

First, it is my understanding that at your previous PS/WP6 meeting, there was general (but not unanimous) agreement that if certain modifications were made to the HD300's signal (i.e., colorimetry, gamma and black level), its performance would be effectively equivalent to the several BTS cameras and, hence, it could be used to generate 1125/60 test material. You have informed Lex that these changes have been made.

Mr. Craig Tanner
January 25, 1991
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Second, although the test data reveal that the performance of all cameras are not equal, the concern of those parties wishing to exclude the Sony camera from the production effort has to do with the camera's relative noise performance. Some test data on noise performance of the various cameras have been gathered, but due to the procedures followed in collecting that data, uncertainty exists as to whether the test results can be compared directly. It is generally agreed, however, that the HD300 has slightly better noise performance than BTS Camera #2 (the newest BTS camera which can be configured to operate in the 1125, 1050, and 525 proscan formats), and both of these cameras have somewhat better noise performance than BTS Camera #4, which is configured for 787.5.

Third, at yesterday's meeting, the Ad Hoc Group on Production Planning, which performed the camera tests, expressed indifference as to use of the Sony camera in the production effort.

Finally, at your meeting yesterday, proponent representatives declared their positions on the question. Representatives of the Advanced Television Research Consortium and Zenith opposed the use of the Sony camera; representatives of General Instrument and NHK supported its use. No representative of MIT was present at the meeting.

Although I concur generally with the notion that the Advisory Committee ought to be testing transmission systems not cameras, as a practical matter it is impossible to create a perfectly "level playing field" in testing systems with such fundamentally different parameters. Accordingly, so long as other proponents are not markedly disadvantaged, I believe that proponents ought to be allowed to use the best available source material. The facts here suggest that other proponents will not be disadvantaged to any significant degree.

It seems highly unlikely that a standards recommendation by Advisory Committee would be determined solely by the results of the basic quality tests. From the information before me, it appears that any perceived quality differences arising from camera variations are likely to be minimal, especially in comparison with the variance of the recorded subjective data. Therefore, it seems highly unlikely that whether the Sony camera is employed or not will be of

Mr. Craig Tanner
January 25, 1991
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decisional significance in any standards recommendation rendered by the Advisory Committee.

Moreover, in light of the performance difference among the BTS cameras, any principaled argument to exclude the Sony camera would necessarily also include reducing the performance of BTS Camera #2, a position which, as I understand it, no one favors.

After carefully evaluating the various arguments, it is my judgment that proponents ought to have the option of using test material produced with the Sony HD300 camera. Accordingly, I am instructing you to make the arrangements necessary to employ the Sony HD300 camera in the test material production effort.

Sincerely,



Richard E. Wiley
Chairman, Advisory Committee on
Advanced Television Service

cc: Advisory Committee Members
Lauren Belvin
J. Peter Bingham
James E. Carnes
Irwin Dorros
Carl Eilers
Joseph A. Flaherty
Alan S. Godber
Keiichi Kubota
Jae Lim
Wayne C. Luplow
Robert McFarlane
Robert M. Rast
Thomas P. Stanley
Roy J. Stewart
Mikhail Tsinberg

DAVID SARNOFF RESEARCH CENTER
Subsidiary of SRI International
CN 5300
Princeton, N.J. 08543-5300

F a x

DATE: February 27, 1991
TO: CRAIG TANNER
COMPANY: CableLabs - Colorado
RAPIFAX #: (303) 939-9189
FROM: JACK FUHRER (609) 734-2011

Craig:

Confirming our telephone conversation of this afternoon, I agree to your judicious use of the transconverter for some of the 525P shoots. As agreed, you will use your best judgement regarding which motion sequences are acceptable for transconversion.

Additionally - you may NOT use down-converted NTSC.

If there is a problem with this transmission, please call:

Linda Visconti (609) 734-2012

FAX: (609) 734-2901

FCC ACATS PS/WP6 Subjective Testing
Ad Hoc Group on Production Planning

Report on Activities for 4th Interim Report
February 19th, 1991

Summary

During the period since the Third Interim report, the Ad Hoc Group has worked on preparation of cameras for the studio shoot and for the telecine image transfer, the telecine transfer, and graphics image creation. The Group has met eight times in the period, a Camera Test SubGroup whose test manager was Hank Mahler met three times formally and many times during camera testing, and a Film Transfer Task Force chaired by Carl Eilers met twice by telephone. The selection of film material was conducted by the Ad Hoc Group, but then the work was transferred to a newly established Subgroup under Bronwen Jones.

Camera Testing

During the period, BTS offered to loan free of charge a BTS KCH-1000 camera similar to the NBC camera to provide backup for the subjective test materials creation. BTS also offered to loan an LDK6A NTSC camera for the creation of test materials. Sony offered to loan an HDC-300 camera for the test materials creation.

The subgroup on camera testing planned and then executed a series of tests on four cameras from BTS covering all four ATV production formats and NTSC, and a Sony camera operating on 1125 lines. Members were Hank Mahler, (CBS); Jay Ballard, Alan Godber, (NBC); Carl Eilers, Wayne Bretl, (Zenith); Fred Van Roessel, (BTS); Jim Gaspar, (CBS, then Panasonic); and Mike Davis, (Cap Cities/ABC). Additional representatives from BTS including Dr. Mohammed Marey, and from Sony, provided a significant amount of effort in a consultation capacity for their cameras. Fujinon were also present to install and test a replacement lens on the Sony camera.

Testing of cameras took place primarily at NBC Advanced TV Lab in New York, in October and November, and intermittently during December and the first half of January.

In addition to the participants listed above, Jim McGrath (A.F. Associates) was present a number of times to interface the cameras to the EPO robotics unit. Bob Flory and Bob Plummer (Sarnoff) were present on a number of occasions, and Ken Michel (Cap Cities/ABC) was present a couple of days. LeRoy DeMarsh (Kodak) assisted with colorimetry calculations and analysis. Bill Hogan (Sprocket Video) and Bruce Penney (Tektronix) gave some assistance, and Steve Talley (Magni Systems) assisted by telephone.

Significant improvements were made to all four HDTV cameras, before and as testing proceeded.

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Cameras Tested

1. NBC BTS KCH-1000 Camera operating at 1125/60/2:1; 1050/59.94/2:1 and 525/59.94/2:1 formats, with Fujinon Lens HD R14x12.5.
2. On Loan BTS KCH-1000 Camera operating at 1125/60/2:1; 1050/59.94/2:1 and 525/59.94/2:1 formats, with Fujinon Lens HD R14x12.5.
3. On Loan Sony HDC-300 Camera operating at 1125/60/2:1 format, initially with Fujinon Lens, then with Fujinon Lens, and then with Fujinon HD HR14x12.5E.
4. Zenith BTS KCH-1000 Camera operating at 788/787/59.94/2:1 format, with Fujinon Lens HD R14x12.5.
5. On Loan BTS LDK6A Camera operating at 525/59.94/2:1 format, and Angenieux Lens 15x13, and later Canon ?? lens.

Changes and Improvements Made to the Cameras

The changes and improvements which were made were as follows:

The primary work involved modification to certain parameters of the Sony camera and correction of a number of small deficiencies in the BTS cameras, improvements to the Zenith Image Enhancer, and maintenance of the NTSC camera.

The Sony camera colorimetry was modified to meet SMPTE 240M standard and to match the BTS cameras, and the grey scale near black was made more linear, to match the BTS cameras, and a Fujinon lens which had the same zoom range as the Fujinon lenses on the BTS cameras and also was as identical as possible was fitted. This work was carried out in November and the first half of December by Sony and Fujinon.

The NBC KCH-1000 camera was updated to match the performance of the loaned KCH-1000. Later the BTS cameras were modified to correct a slight error in aspect ratio, and pulse timing. The two triple standard BTS cameras were modified to remove automatic registration in the green channel, which had a tendency to produce a visible mottling effect in flat areas. The Zenith camera was similarly modified. Black specks which showed intermittently in BTS Camera #2 were traced to a particular board. A replacement board was shipped from Europe, and was installed. BTS camera #1 (NBC) had an intermittent control panel hangup. The problem was traced to the wiring of a control cable and cured.

Further work was done to reduce clock crosstalk in the Zenith Image enhancer.

The LDK6A NTSC camera was determined to require cleaning of the optics. This was done by BTS, and the performance was then seen to be much improved.

-3-

Remaining Deficiencies

A very slight compression near black still remains in the Sony camera.

The BTS loaned camera, #2, has a slight waterfall effect probably caused by the switching power supply. It is not measurable on a waveform monitor, because it is too small, but it is just visible when standing close to a 28" picture monitor. BTS reported that because of its very small amplitude, it is very difficult to trace the origin.

Tests Conducted

The tests which were conducted were as follows:

The generic tests which were conducted in 1125, 787.5 and NTSC formats, unless otherwise identified, were as follows:

1. Sync & Blanking
2. Preamplifier Response
3. Sensitivity
4. MTF All scanning modes
5. SNR All scanning modes
6. Shading
7. Image Retention
8. Registration
9. Geometric Distortion
10. Lag
11. Gamma
12. Colorimetry

Split Field tests at 1125 lines

13. SNR
14. Lag
15. Colorimetry

Enhancement Calibration

Alignment Instructions for Change of Standards for Cameras.

Alignment Instructions for Daily Setup of Cameras.

Notes on the Tests

1. Sensitivity

Neutral density filters were installed at the filter wheel positions in all cameras except the Zenith BTS camera to compensate for differences in sensitivity. Jim Gaspar arranged for these filters. The Sony camera and the LDK6A NTSC camera were operated at 0dB gain, and the BTS cameras were operated at -3dB gain.

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2. SNR

After modification of the linearity near black, and colorimetry of the Sony camera #3, its SNR was measured as slightly better objectively (probably 0 to 2dB), than BTS KCH-1000 Camera #2, and a little further less noisy than Zenith BTS KCH-1000 Camera #4 (1 to 4dB). The SNR of cameras #2 and #3 appeared effectively the same subjectively with perhaps a slightly different character to the noise between the two cameras.

3. Colorimetry

The colorimetry of camera #3 was modified to bring it close to SMPTE 240M. Using the EBU chart, sets of readings were taken of the 25 color patches, and the maximum and mean deviations from the 240M standard were calculated. This was done before and after modification of the camera. LeRoy DeMarsh advised that the Sony camera should now look closely the same as the BTS cameras from a colorimetric viewpoint. It was felt that when viewed sequentially no difference would be detectable, but some differences would be seen when observed simultaneously on a split field. This was confirmed by observation.

Discussion

Camera #3, Sony, had slightly higher performance in MTF and upper limit of the image enhancer than the BTS cameras, and in SNR cameras #2 and #3 were essentially equal subjectively, although objectively camera #3 was a little less noisy than camera #2, which was a little less noisy than camera #4. Camera #1 is still somewhat inferior in quality compared to camera #2, -due to differences in camera tubes. The colorimetry of all cameras was close enough for no difference to be detectable with sequential presentations.

In all other respects the performance of cameras #2, #3, and #4 were essentially equal.

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Camera Combinations - Recommendations for Use

To produce the images required in the five production formats, the options listed below were found to be the most desirable.

Format	Camera
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788/787	- Zenith BTS camera (#4).
NTSC	- On Loan BTS LDK6A camera (#5).

1125/60/2:1
1050/59.94/2:1
525/59.94/1:1

Option #1	Use of Sony Camera #3 for 1125 lines format, BTS Camera #2 for 1050 and 525 line format. BTS camera #2 would act as back-up for the Sony camera in 1125 line format, and Camera #1 would act as backup for Camera #2 in terms of boards, modules, etc.
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Option #2	Use of one camera head (#2), with two CCU's, one aligned for 1125/60, and one aligned for 1050/525 switchable. Option #2 would be the backup mode in case of failure of the equipment.
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Option #3	Use of BTS Camera #2, with extra boards from Camera #1 to permit quick change of standards from 1125 to 1050 to 525 and back. Sony Camera #3 would provide backup for the 1125 format.
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Image Enhancement

Image enhancement of Cameras #2 and #3 was compared by a group of 7 engineers. The BBC Test Chart #64 was used as reference. The subjective image was observed first with no enhancement, and then with enhancement added in varying degrees, until the group agreed that the enhancement was optimum and produced a pleasing picture. The overshoot measured on a waveform monitor observing a 50% window was then measured, and the overshoot noted. This was repeated for the two cameras and the results compared by split screen. The amount of overshoot on both cameras was between 10% and 12%, and this was therefore determined to be the optimum amount of enhancement. A multiburst measurement was made and the results were found to be comparable for the two cameras (when the peaking frequencies were optimized). Settings on the two cameras of peaking frequency were noted and the amount of enhancement. Photographs of the control panel settings were taken. Camera #4 and #1 were tested for the same results, and control settings noted. The NTSC camera was set for approximately 10% overshoot.

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Telecine

The film transfer unit was constructed during this period, and this work was coordinated by Carl Eilers (Zenith) with Wayne Bretl, (Zenith), Greg Thagard, and Vaughan Howes (Showscan), Also participating in the Task Force or assisting with this work was Fred Van Roessel (BTS), LeRoy DeMarsh (Kodak), Alan Godber (NBC), and Keeichi Kubota (NHK).

Various iterations of the unit were created with a number of improvements being made. Image stability problems were encountered, but improvements to the jump and weave characteristics were made and are now considered satisfactory for 35mm film and are also adequate for 65mm film. This result is based on test films obtained from SMPTE. Temporary optics were first used, while a special lens was being manufactured. Two versions of shutter blade were tried. The unit will now operate with 35mm. film at 24fps and 30fps, and with 65mm. film at 60fps. The unit is designed to operate with interpositive film stock in order to match the available characteristics of the studio cameras which will be used with the unit.

Synchronization of the telecine to pull-down between field two and one and consistency of the 2/3 pull-down from format to format were resolved.

Transfer of video images from the telecine into the Zenith DVS unit were resolved with DVS. A software update to facilitate this function was provided by DVS. The DVS unit is able to accept one field at a time of each of the four HD production formats and NTSC.

Bill Hogan (Sprocket Video), and John Galt (Sony), investigated whether the Sony recorder could edit single field. A parallel effort was made by Bill Hogan and Bronwen Jones (Consultant), to obtain access to a Sony Solid State recorder. Sony did not have one available to loan to the committee.

Recording of single field or frame on an HD recorder was tested by Bob Plummer and was found to be possible. However, to reduce wear and tear on the HD digital recorder and to improve reliability it was decided to transfer the film images in 4 second segments into the Zenith DVS, and into a D1 recorder set as a data store, and then to check the stored result back through the DVF. When all images have been stored on the D1 recorder, they would be retransferred back through the DVS to an HD digital recorder via a format converter.

A detailed specification of the film transfer device is in preparation including the optical path, mechanical structure, film to video transfer characteristics, and colorimetric parameters, single line diagram of the electrical transfer process, and test images to be used.

The film transfer process is presently scheduled to take place from March 11th through March 30th including production of the images in the recorded form suitable for presentation to the Advisory Committee and ATTC.

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Selection of Film Images**35mm 24fps Film**

Film was obtained from Columbia and Paramount and VHS copies of these movies were given to Bronwen Jones Subgroup to view.

35mm 30fps Film

Film was obtained by Bronwen Jones, Bill Hogan and others from Kodak. This was then viewed by Bronwen Jones Subgroup.

65mm Showscan Film

Five possible segments of 65mm film were chosen by the Ad Hoc Group. This was edited by Greg Thagard and presented to Bronwen Jones Subgroup for review.

Graphics

Bill Hogan and Greg Thagard proposed that Symbolics be used to create the desired graphics image in the five production formats. It was later to proposed to transfer this activity in part and then in total to DeGraph Wohrman and then Craig Tanner negotiated to obtain a proposal from DeGraph/Wohrman to completely prepare the graphics segments consisting of one still and one motion sequence. Paul Hearty negotiated the image content of the still and motion sequence with DeGraph/Wohrman. The technical proposal was reviewed by the Ad Hoc Group and found to be sound.

It was proposed to transfer these images to the five formats concerned using the ATTC PIXAR equipment, but this turned out to be very time intensive and the PIXAR could not be made available by ATTC.

A proposal was made at the January PS/WP6 meeting by AT&T Bell Labs to produce the graphics image, and to transfer into the five formats and onto digital video tape using the DVS system at Zenith in Glenview, contiguous with the film transfers during March. The proposal from AT&T is due to be presented imminently.

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